ELECTROMYOGRAPHIC SUBSTANTIATION OF THE FEASIBILITY OF MYORELAXING SPLINT IN THE TREATMENT OF TMJ DYSFUNCTION

Tetiana KOSTIUK[1], Evgen Koval[2], Serhii PALAMARCHUK[2], Marianna PALAMARCHUK[2], Renata SYMONENKO[2]

[1]Assoc. Prof. MD, "Bogomolets" National Medical University Kiev, Ukraine
[2]Assoc. Prof. PhD, "Bogomolets" National Medical University Kiev, Ukraine
Corresponding author: Tetiana Kostiuk; e-mail: k-tm@ukr.net

Abstract

Our study allowed us to trace and analyze changes in the chewing muscles of patients that occur during the treatment of tempoal-mandibular joint dysfunction (TMJ), and to indicate its effectiveness. In patients with TMJ dysfunction, qualitative and quantitative indicators of electromyography closely correlate with the stages of pathological development and correspond to its clinical manifestations. In this study, for the first time, the relationship between changes in the parameters of the frequency of muscle contractions and the subjective sensation of pain in the area of the specified chewing muscle in patients was analyzed. The purpose of the study is a comparative analysis of the nature and degree of changes in the electromyographic activity of the main and auxilliary chewing muscles in patients with TMJ dysfunction before and after the use of myorelaxing spleen. Materials and methods. A five-year study on patients with TMJ dysfunction (109 people). The general analysis provided 1,024 electromyograms before and during the stages of treatment. The results of the analysis on the effectiveness of the use of myorelaxation tires in the treatment of TMJ dysfunction can improve the quality of treatment of this pathology. The results obtained after 12 months indicate that the effectiveness of treatment in patients with KG I (with the lowest intensity of symptoms of TMJ dysfunction) reached 89.1±1.3%, and in those with KG II – up to 78.3±1.3%, respectively.

Keywords: *electromyography, dysfunction, temporomate-mandibular joint, chewing muscles, facial muscles, bioelectrical activity, bioelectric rest, splin, visual-analog pain scale (VAS)*

1. INTRODUCTION

The problem of an effective diagnosis and treatment of TMJ dysfunction was and, unfortunately, remains one of the main challenges of modern dentistry. Analysis of its sharp increase in annual patient appeals and its general high prevalence is due to the variety of complaints and clinical manifestations of this pathology. Diagnosis and treatment of TMJ dysfunction have a multidisciplinary, fundamental and individualized approach [1]. 80% of adults and almost 25% of children and adolescents have clinical manifestations that meet the criteria for the diagnosis of TMJ dysfunction [2,3]. The number of patients with TMJ dysfunction is increasing every year [4]. A sharp increase in the prevalence of the disease is due to the peculiarities of the etiopathogenesis of TMJ dysfunctions: the initial stages are asymptomatic and the primary organic changes cannot be controlled [4,5].

Diagnosis and treatment of TMJ dysfunctions are complicated by the fact that 95.7–98% of such patients have complications in the form of pain burden [5]. The pain that accompanies this pathology is chronic and differs from other types of pain. Structural and functional neuroplastic changes in the brain, which occur in patients with TMJ pain dysfunction, are caused by the processes of peripheral and central sensitization. It is possible to stop such pain only if it is possible to activate the process of reversible development of the already formed structural and functional changes. Such functional changes in various departments of the central nervous system damage the processes of transmission of nerve impulses. As a result of these injuries, neuroplastic changes in these departments occur, which explains what we observed in patients with TMJ dysfunction, namely that they feel pain even after the cessation of the triggering stimulus. In these cases, the phenomenon of pain loses its protective function and turns from a symptom of primary signaling value into a formed independent disease [5]. When researching the

etiopathogenetic mechanisms of the development of TMJ dysfunction, neuromyogenic factors are dominant. The paradigm of symptoms is the main basis for the existing traditional methods of treatment of TMJ muscle and joint dysfunction [6]. That is why, the priorities in the treatment of painful TMJ dysfunction are myorelaxation and drug therapy, to relieve pain symptoms in patients.

Transformation of the usual myotatic reflex should be carried out using therapeutic splints. To adjust the load in the chewing and facial muscles, we use myorelaxing splints made with the help of «EXOCAD» digital technology. Mechanism of action of the splint: a planned artificial occlusal space is created, which replaces the usual occlusal relationships, promotes stretching of the fibers of the masticatory muscles and triggers the transformation of the load inside the masticatory muscle. It is necessary to use such a medical splint for at least 16-18 hours a day, and to adjust the occlusal surface of the splint every 3-4 weeks of its regular use.

The **aim** of this study is to compare the nature and degree of changes in the electromyographic activity of the main and auxilliary masticatory muscles in patients with temporomandibular joint dysfunction before and after treatment with myorelaxing splints.

The **object** of the study: a representative contingent of patients including 109 subjects, of whom 74 (67.9%) were females, and 35 (32.1%) patients were males. In total, 1,024 electromyograms were analyzed at different stages of patient management. For five years (2017-2021), we conducted examination and treatment of TMJ dysfunction on the basis of the Dental Medical Center of the "O.O. Bogomolets" National Medical University.

2. MATERIALS AND METHODS

Electromyographic research of the main and auxilliary masticatory, as well as of the facial muscles, was carried out with the help of a modern computer complex ioEMG III (BioRESEARCH Associates, Inc., USA). To date, this is the only system for electromyography of the maxillofacial area, which allows to determine the parameters both at rest and during clenching and chewing in one recording, without a phase shift. To conduct the research, we chose the technique of surface functional EMG [6]. To record the bioelectric potentials, we used standard skin disposable surface bipolar electrodes from BioResearch (VioFLEH, USA). The electromyographic study of masticatory muscles began with the physical determination of the motor point of the studied muscle, a dense formation, for whose identification we ask the patient to squeeze the teeth with force. The skin in the projection above the motor point was degreased with ethyl alcohol and electrodes with a self-adhesive surface and fixed. The grounding electrode was placed on patient's right wrist.

All patients had clinically diagnosed TMJ dysfunction and, according to the clinical manifestations and degree of the dysfunctional changes, they were divided into two studied clinical groups (CG). According to the degree of damage to the TMJ, the Helkimo index ranges from 5 to 25, namely:

1. In the first clinical group (CG I) - 98 people (89.9%) - treatment was carried out according to the proposed method with the use of muscle relaxation splints;
2. The second clinical group (CG II) - 11 people (10.1%) - was treated according to the traditional algorithm.

The following samples were subjected to analysis: the resting state of patient's muscles, voluntary chewing, volitional compression of the chewing muscles and prescribed one-sided chewing, swallowing, free opening of the mouth. The study was given the following periods: the state before the application of splint therapy, six months after the start of treatment (Fig.1). At the same time intervals, patient's subjective complaints were analyzed based on the visual analog pain scale and axiography data.

Qualitative and quantitative parameters of electromyography, axiography, and pain screening were also analyzed. Pain analysis used a modified 10-point FPS-R Bayers scale (recommended by the World Association for the Study of Pain - IASP).

3. RESULTS AND DISCUSSION

The parameters of the state of rest norm, in the absence of the impact of the load on the dental and jaw apparatus or of the influence of other irritating factors, as well as in the absence of pathological changes in the structure of the muscle itself, register a uniform clear isoline on the monitor. The norm of the volitional compression test of the masticatory muscles is the registration of a masticatory wave with a uniform build-up of ascending and descending action potentials. The parameters of maximum and average amplitude of the action potentials of the masticatory cycle were subjected to analysis and comparison.

Table 1. Indicators of volitional compression in the main masticatory muscles of patients of KG I before and after treatment by the proposed method

Parameter	Me (Q_I – Q_{III})		Certainty, p
	CG I, To (n=70)	CG I, After (n=70)	
BC_TA_R_A_max	108.6 (108.6 – 110.8)	101.7 (97.9 – 111.1)	<0.001
BC_TA_L_A_max	117.9 (113.7 – 117.9)	101.8 (98.3 – 110.9)	<0.001
BC_TA_R_A_mean	89.5 (85.9 – 89.5)	85.9 (78.9 – 89.4)	<0.001
BC_TA_L_A_mean	82.8 (82.8 – 83.9)	82.45 (79.1 – 82.9)	<0.001
BC_MM_R_A_max	177.9 (176.8 – 178.3)	164.45 (157.3 – 175.8)	<0.001
BC_MM_L_A_max	176.9 (175.9 – 178.4)	165.55 (158.3 – 176.9)	<0.001
BC_MM_R_A_mean	59.5 (57.2 – 60.8)	56.89 (54.8 – 60.2)	<0.001
BC_MM_L_A_mean	60.5 (57.4 – 61.9)	55.85 (53.8 – 61.1)	<0.001

Table 2. Indicators of volitional compression of the main masticatory muscles of CG II before and after treatment by the traditional method

Parameter	Me (Q_I – Q_{III})		P
	CG II, To (n=11)	CG II, After (n=11)	
BC_TA_R_A_max	110.8 (108.6 – 124.45)	108.6 (108.075 – 110.8)	0.219
BC_TA_L_A_max	117.9 (113.025 – 121.5)	108.9 (108.6 – 110.8)	0.019
BC_TA_R_A_mean	89.5 (86.8 – 106.675)	89.5 (86.8 – 89.5)	0.188
BC_TA_L_A_mean	82.8 (82.8 – 99.25)	82.8 (82.8 – 89.3)	0.188
BC_MM_R_A_max	160.6 (158.3 – 162.7)	160.6 (158.3 – 160.6)	>0.999
BC_MM_L_A_max	176.9 (175.9 – 178.4)	162.7 (158.875 – 173.05)	0.004
BC_MM_R_A_mean	54.3 (53.375 – 58.05)	63.4 (57.925 – 65.175)	0.027
BC_MM_L_A_mean	61.6 (59.85 – 63.2)	63.9 (57.45 – 66.675)	0.301

Note: Wilcoxon t-test for paired samples was used for pre- and post-treatment comparisons.

All patients of the studied clinical groups (100%), with no exception, had impaired muscle activity before the treatment.
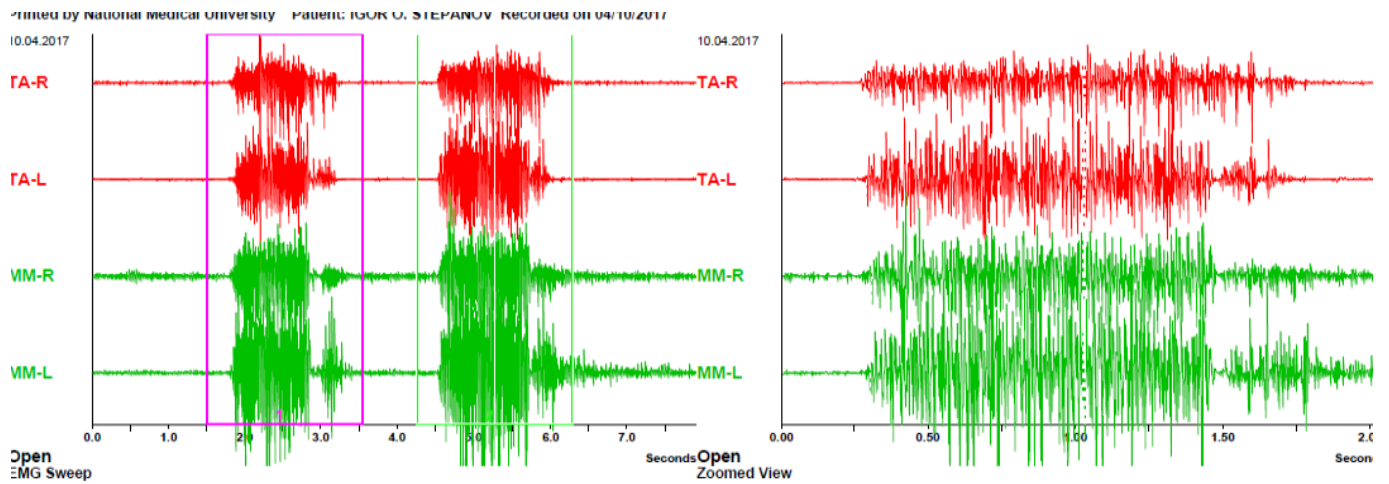
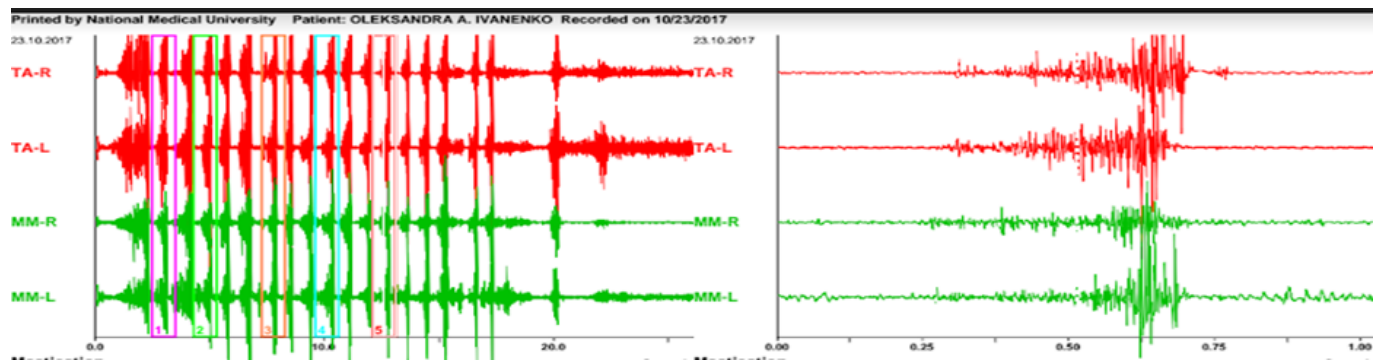**Fig. 1. EMG of volitional compression of patient's masticatory muscles before the treatment**

Fig. 2. EMG of volitional compression of patient's masticatory muscles after the treatment with traditional methods
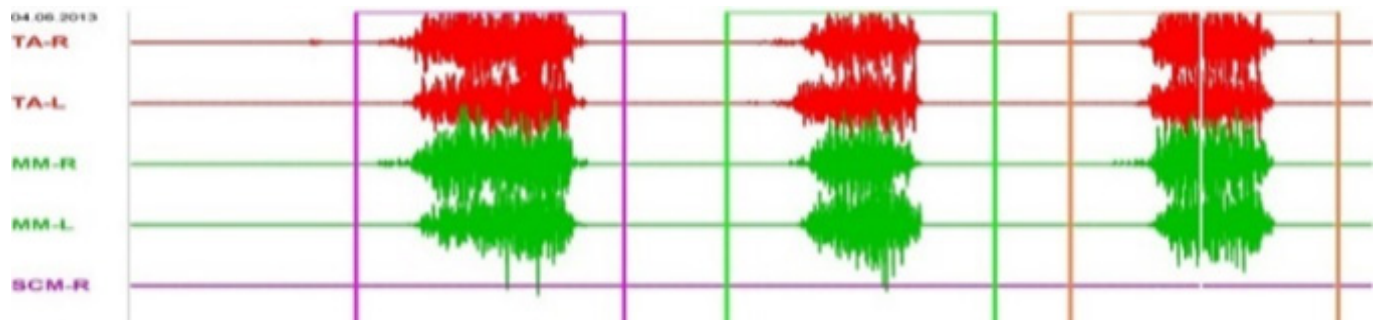

Fig. 3 EMG of volitional compression of patient's masticatory muscles after the treatment with a myorelaxant splint
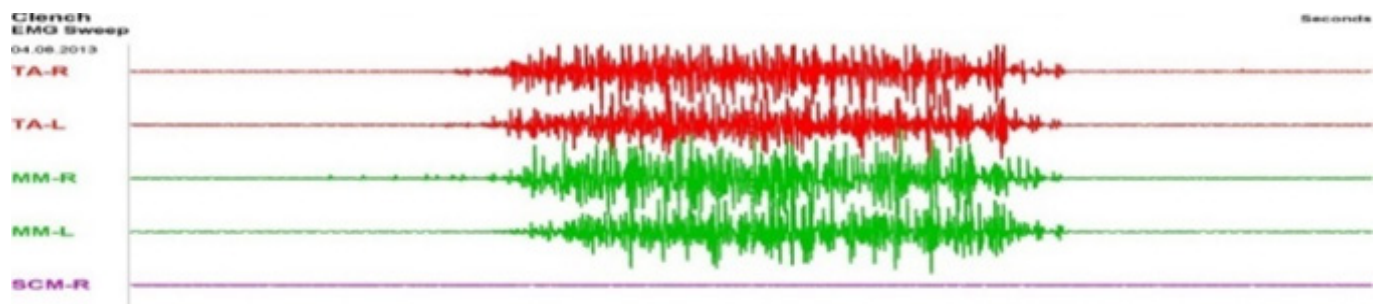

Fig. 4 EMG of volitional compression of patient's masticatory muscles after the treatment with a myorelaxant splint (inversion)

The results obtained and analyzed after 6 months indicate normalization of the structure of the chewing cycle: qualitative and quantitative components. Comparing the obtained results on the effectiveness of treatment with the results on the effectiveness of TMJ dysfunction treatment by traditional methods, a significant difference in quantitative data was observed.

We also noted that the effectiveness of treatment of patients from the studied clinical group reached 89.1±1.3%, compared to the usual analog parameter of traditional treatment schemes, which does not exceed 55.4±1.3%.

4. CONCLUSIONS

This reseach made it possible to analyze and combine the interdependence of the value of the subjective parameter of pain and the objective parameters of the bioelectrical changes of the masticatory muscles both before and after the treatment of patients with TMJ dysfunction. The results of the conducted statistical analysis of the effectiveness of myorelaxation splints in the treatment of TMJ dysfunction allow to improve the quality of treatment of this pathology. The results obtained after 6 months indicate that the effectiveness of treatment in patients of the studied clinical group reached 89.1±1.3%, compared to the usual analog parameter of traditional treatment schemes, which does not exceed 55.4±1.3%.

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